

# Bat Ticks of the Genus *Argas* (Ixodoidea, Argasidae). 1. The Subgenus *Chiropterargas*<sup>1</sup>

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Certain ticks of the genus *Argas* parasitize bats in Europe, Africa, and Asia, but their species identity and subgeneric position have never been clarified. Vague early descriptions, scarcity of study specimens, and confusion between immature and adult stages of different species have resulted in numerous misconceptions concerning these ticks, as suggested by Kohls (1950, p. 4).

In Egypt, we are particularly fortunate in being able to collect large numbers of three important bat-parasitizing species of *Argas* and to rear them in the laboratory. We are also fortunate in having the whole-hearted co-operation of many colleagues who have kindly supplied us with comparative materials from other parts of the world.

In view of contemporary interest in bats and in their parasites as hosts, reservoirs, and vectors of disease organisms, these argasid ticks, potentially of considerable biological importance, should be better understood. A series of papers, of which this is the first, will present data and information we have obtained from field, laboratory, and museum studies. We hope, thus, to stimulate further research on this group of parasites by colleagues in other parts of the world.

In this paper are presented data on two African species of ticks that form a single, distinct evolutionary branch of the genus *Argas*. The tick herein described as *A. confusus* sp. nov. has been widely reported as the adult stage of an entirely different European species,

<sup>1</sup> The opinions or assertions contained herein are the private ones of the author and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

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following the description and illustrations presented by Nuttall *et al.* (1908), whose figures have been frequently reproduced in European literature. The considerable differences between the two presently considered species and all others in the genus warrant assignment of the former to a separate subgenus.

### **Chiropterargas** subgen. nov.

Parasites of which bats are hosts of predilection. Morphological characters intermediate between those of typical *Argas* and typical *Ornithodoros*; with a general *Argas* facies but lacking a sutural line; with a flattened body flange but lacking "cells" and with exceedingly slight integumental differentiation at periphery; body shape circular to transversally elliptical. Integument with fine, close, granular projections; discs mostly small, conspicuous, radially distributed; ventral "paired organ" present. Definite hood over mouth-parts; mouth-parts about level with anterior body margin. Legs of variable length, arising from anterior half of body; tarsal humps lacking.

*Type of the subgenus.*—*Argas boueti* Roubaud and Colas-Belcour, 1933. The subgenus also includes *Argas confusus* sp. nov.

### **Argas (Chiropterargas) boueti** Roubaud and Colas-Belcour, 1933.

Figures 122–126.

*Argas boueti* Roubaud and Colas-Belcour (1933, pp. 472–477, figs. 1–6 and pl. 28); descriptions and illustrations of both sexes and immature stages from tree-holes at Djenné, French West Africa, collected by G. Bouet about 1911; type material in collections of the Pasteur Institute, Paris; hosts stated to be chiefly *Taphozous perforatus* Geoff., which also show a trypanosome infection; morphological adaptations of cave-inhabiting ticks discussed. Heisch (1951, p. 354, figs. 1 and 2) reported adults on walls of underground concrete shelter and larvae from *Megaderma cor* Peters, in Northern Province, Kenya; female illustrated. Hoogstraal (1952, pp. 118–120, figs. 1, 2) noted specimens from Equatoria Province, Sudan, and reported frequent occurrences in caves and buildings in the Cairo area; listed thirteen species of local bats infested, and recorded laboratory and field observations on feeding, egg-laying, and activity; male illustrated. Hoogstraal (1954a, p. 5) noted presence of this species in (Jerusalem) Palestine. Hoogstraal (1954b, p. 305) noted larvae and nymphs from Equatoria Province, Sudan, from *Taphozous perforatus haedinus*.

The following re-description is based on one hundred specimens of each sex and stage from the environs of Cairo, Egypt.

**MALE:** Body of "small race" (excluding hood) measures from 4.6 to 5.4 mm. long, and from 4.0 to 4.7 mm. wide (average specimen 5.0 mm. long, 4.5 mm. wide); body of "large race" (excluding hood) measures from 6.2 mm. to 9.0 mm. long and from 5.8 mm. to 6.8 mm. wide (average specimen 6.8 mm. long and 6.9 mm. wide); shape varying from circular to pear-shaped; anterior margin with a large hood usually concealing all or most of mouth-parts from dorsal view. *Dorsal integument* with finely granular, mostly flat-tipped, closely spaced, minute protuberances,

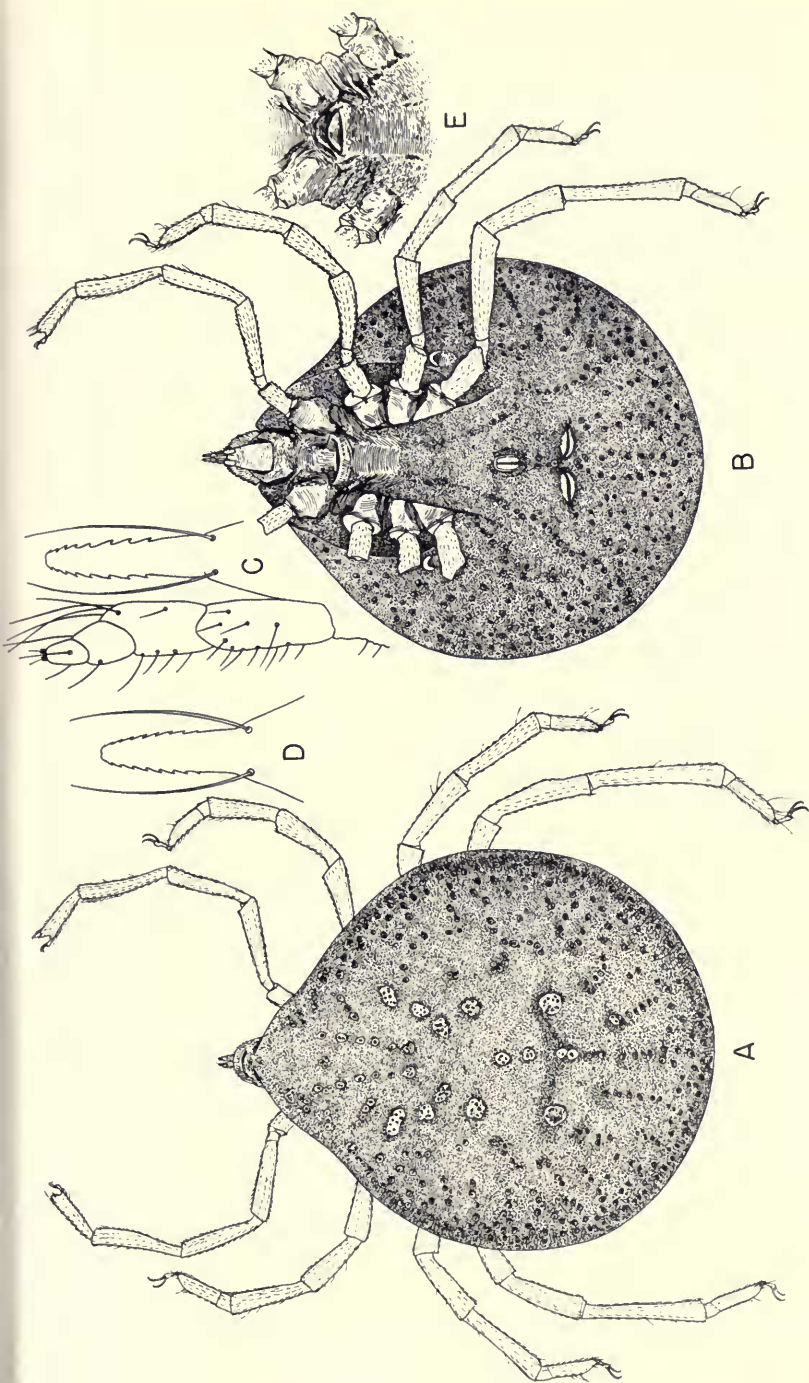


FIG. 122. *Argas boueti* Roubaud and Colas-Belcour; "small race." Female: A, dorsal view; B, ventral view; C, hypostome and palpi, ventral view. Male: D, hypostome, ventral view; E, genital area.

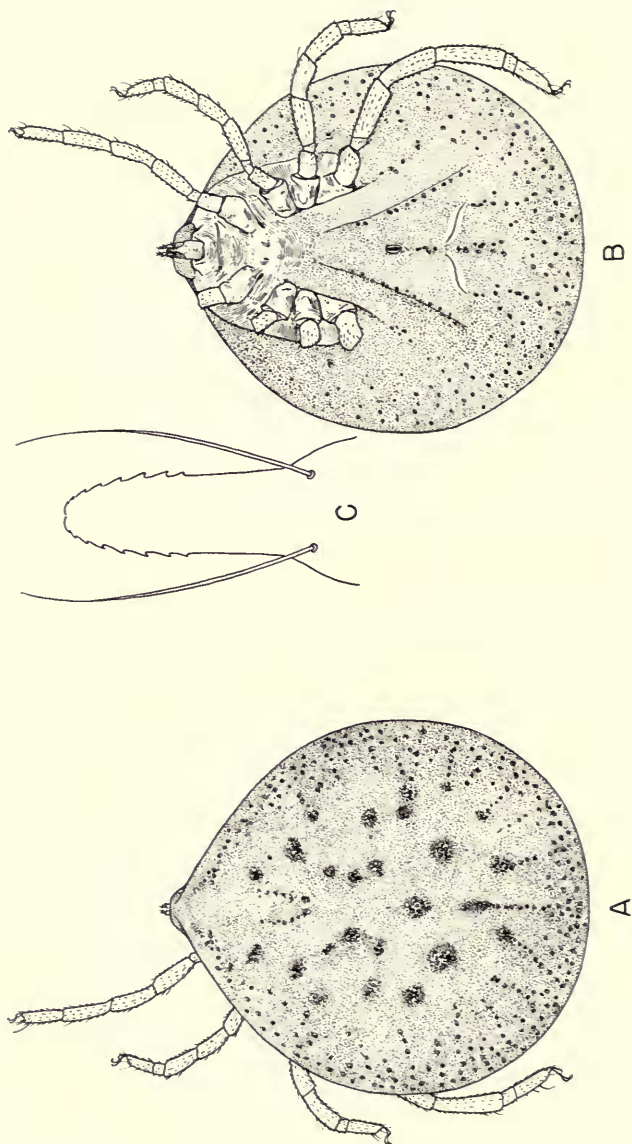


FIG. 123. First instar of nymph of *Argas boueti* Roubaud and Colas-Belcour; "small race." A, unengorged, dorsal view; B, unengorged, ventral view; C, hypostome, ventral view.



these more rugose towards periphery; hairs short, pale, widely scattered on dorsum (hairs longer, more numerous, and much more apparent on specimens of "large race"); discs small, conspicuous, distributed as illustrated. *Peripheral integument* dorsally differentiated by a row of short, faint, integumental ridges which are narrow, slightly elevated, and irregularly parallel (ridges are not discernible on greatly engorged specimens or on specimens in fluid); laterally with about eight rather regular rows of low protuberances which are circular or narrowly elongate, and with minute, short, widely spaced hairs (sutural line absent); ventrally with little apparent differentiation. *Hood* large and conspicuous, arising from antero-lateral body margin, completely concealing mouth-parts except when the basal tube is swollen; lateral margins parallel or converging anteriorly, anterior margin bluntly rounded; a few short hairs on lateral and ventral surfaces. *Capitulum* in deep camerostome; *basis capituli* longer than wide, with lateral margins gently curved; *hypostome* about one-fourth as wide as long, with a single pair of files of weak lateral denticles (1/1) that become progressively longer basally, eight or nine denticles in each file confined to anterior two-thirds of hypostome; apex slightly emarginate; a pair of long posthypostomal hairs extending beyond apex of hypostome; *palpi* slightly longer than hypostome, segments comparatively narrow, progressively shorter from basal segment to apical segment; segment 1 almost three times as long as wide, segment 2 twice as long as wide, segments 3 and 4 each about as long as wide. *Eyes* absent. *Spiracular plates* lateral to coxa IV. *Genital aperture* straight, level with base of coxae I; lips smooth; anterior lip gradually rounded to form an arc. *Anus* situated slightly posterior to body midlength (excluding hood); eight or nine hairs on each valve. *Posterior paired organs* situated between one-fourth and one-half of distance between posterior margin of anus and posterior body margin. *Coxal and supracoxal folds*, and *postanal median groove* present. *Legs* remarkably long and slender; coxa I widely separated from coxa II, other coxae contiguous, arising from anterior half of body; leg IV (exclusive of coxa) about five-sixths as long as body (exclusive of hood); tarsi II to IV abruptly tapered; tarsus I with distal margin deeply emarginate; all tarsi lacking dorsal humps. *Pads* very small. *Claws* long on all legs except I.

**FEMALE:** Similar to male except that size averages about 25 per cent longer and genital aperture is bounded by two rugose lips. Maximum size observed (exclusive of hood) 9.4 mm. long and 7.3 mm. wide.

**NYMPHS:** Similar to adults except for size and absence of genital aperture; third instar nymphs may equal males in size. In the first instar, stretching of integument with engorgement is especially great and the body and leg length ratio of engorged specimens is greatly altered; also, with extreme engorgement the hood may be more or less completely ventral in the first instar; the hood in the first two instars is shorter and more truncate than in adults, so that the mouth-parts are frequently visible from dorsal view. In nymphs of "large race" the length of leg IV is about 1.25 times that of the body and the others are proportionately long; in nymphs of "small race" leg IV is about 0.66 times as long as the body. It is noteworthy that in nymphs the comparatively narrow and elongate shape of the adult palpi and basis capituli is attained.

**LARVA (unengorged):** *Body* (exclusive of palpi and hypostome) measuring about 0.51 mm. long and 0.46 mm. wide; shape subcircular, somewhat longer than wide, capitulum fully anterior; upon engorgement, body becomes more globose and mouth-parts are partially or completely concealed ventrad of truncate or

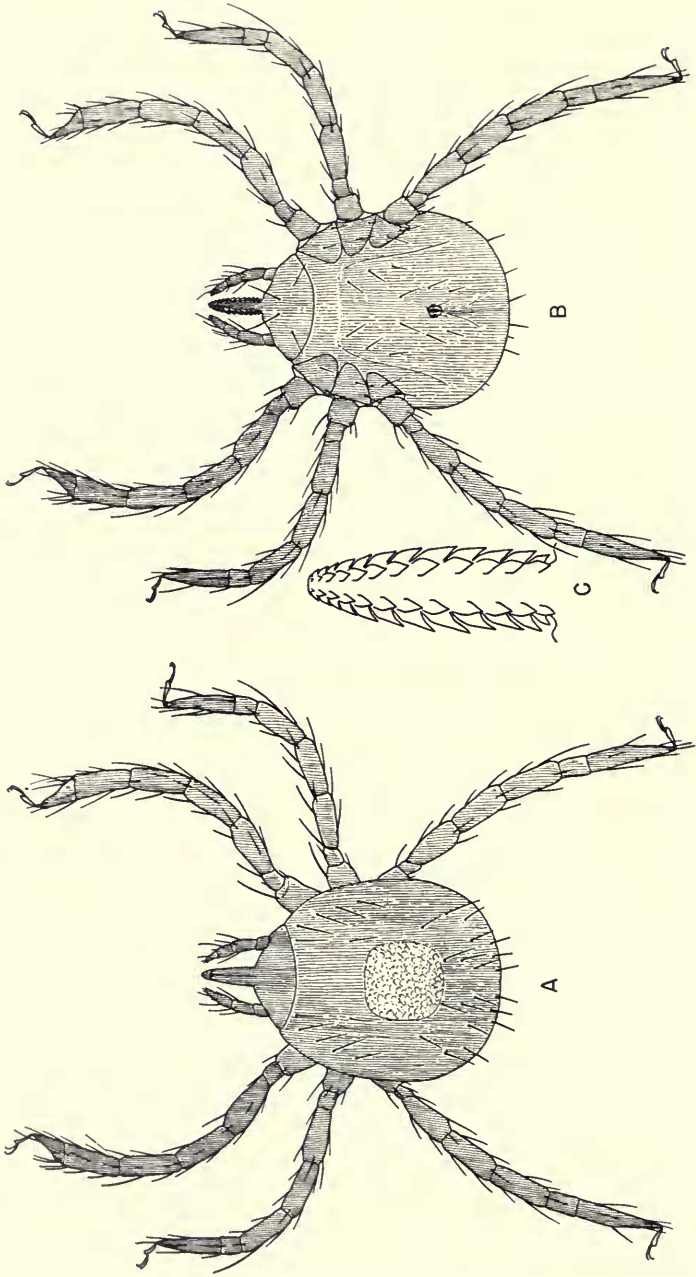


FIG. 124. Larva of *Argas boueti* Roubaud and Colas-Belcour; "small race." A, unengorged, dorsal view; B, unengorged, ventral view; C, hyostome, ventral view.

emarginate anterior margin. Integument with fine striations, which are much more readily discernible when body contains ingested blood. *Hairs* dorsally numbering six on each anterior quadrant and ten on each posterior quadrant; ventrally with three along each subcoxal groove, three or four on each side of the anus, and one arising from each anal valve. *Basis capituli* transversely ovoid. *Hypostome* (from basal denticle) almost three times as long as greatest width; lateral margins

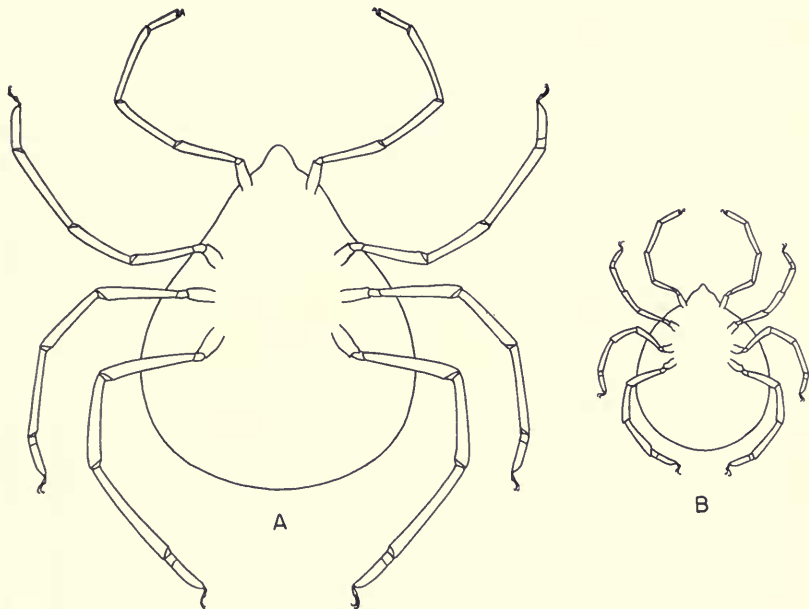


FIG. 125. *Argas boueti* Roubaud and Colas-Belcour. Female (outline): A, "large race," ventral view (including hood, 9.5 mm. long, 7.3 mm. wide); B, "small race," ventral view (including hood, 5.1 mm. long, 4.0 mm. wide).

parallel for basal two-thirds of length, gradually converging anteriorly, apex bluntly rounded and without corona; dentition 2/2, both files of denticles extending full length of shaft, denticles numbering from 11 to 13 in each file; size and shape of denticles as illustrated; posthypostomal hairs reaching almost midlength of hypostome. *Palpi* equaling hypostome in length, segment 2 almost as long as combined length of segments 3 and 4, segments 1 and 4 of about equal length. *Legs* subequal, measuring (not including coxae) about 1.3 times as long as body; coxae contiguous, tarsi gradually tapering, claws and pads of moderate size and subequal.

*Variation:* In describing *A. boueti*, Roubaud and Colas-Belcour (1933) noted that specimens of two size ranges were present in their series and selected their holotype from the material within the larger size range. Their measurements fall within the extremes represented by our numerous Egyptian specimens. In Egypt, the "small

race" is many times more common than the "large race." If only small series of these two "races" from different localities were available, one would logically conclude that the "large race" is a species or subspecies distinct from, but closely related to, the "small race." Although we have noted no intergradation between these two "races" in Egypt, the only morphological differences we can yet ascertain—regularity of integumental granulation, numbers of hairs, and body-leg length ratios—can be attributed to size and robustness. It is yet too early to determine whether these two "races" are valid species or whether the differences are due to nutritional, seasonal, or environmental factors. We do, however, have rearing experiments under way in the hope of elucidating the relationship between the two "races." Because of the slow life cycle of these ticks, it will be more than a year before the final results can be obtained and evaluated.

**Argas (Chiropterargas) confusus sp. nov.** Figures 126–131.

*Argas vespertilionis* (Latreille, 1796), in part; Nuttall *et al.* (1908, pp. 35–36, fig. 48) described and illustrated South African female of *A. confusus* sp. nov. as adult of European nymphs of actual *A. vespertilionis*. Howard (1908, pp. 7–9, pl. 1) described South African females from material apparently representing both *A. confusus* sp. nov. and *A. vespertilionis* group; male, nymphal, and larval descriptions do not apply to *A. confusus* sp. nov.; fig. *m* is female *A. confusus* sp. nov., fig. *k* is larva referring to either species, figs. *l*, *n*, *o*, and possibly *p*, refer to *A. vespertilionis* group. Bedford (1934, pp. 61–65, figs. 8 and 9) described adults of *A. confusus* sp. nov., female illustrated by photograph of dorsal and ventral surfaces; his descriptions and illustrations of nymphs and larvae refer to *A. vespertilionis* group. *Note:* All illustrations referable to *A. confusus* sp. nov. in papers and books on non-African ticks by various authors are copied from Nuttall *et al.* (1908) and do not refer to actual specimens.

**MALE:** Measures (excluding hood) from 5.9 mm. to 6.4 mm. long, and 7.4 mm. to 7.8 mm. wide (average specimen 6.1 mm. long, 7.5 mm. wide). *Body* (unengorged) flat and thin, slightly wrinkled centrally; shape elliptical, with an anterior triangular projection to form base of hood; (engorged) more or less globose centrally with a wide, flattened periphery. *Color* (viewed in liquid) reddish yellow with a darker, opaque antero-medial area of varying extent; darker, irregularly circular discs apparent in yellowish ground color; legs pale yellow; when dry, integument blue-black, legs pale yellow, and coxae and trochanters dark yellowish.

*Dorsal integument* with finely granular protuberances consisting of minute, shiny-tipped, tapering points, closely spaced on central dorsum but becoming more irregular and forming wrinkle-like rows toward periphery of body. *Discs* mostly small, shiny, conspicuous; median and anterior groupings as illustrated, posterior groups arranged in radial lines; disc surfaces varying from smooth to minutely stippled to slightly rugose; most discs bounded by a minute groove with a partly or completely encircling ridge of the same formation as the disc; posterior-ray discs single, others mostly in groups of four to six almost contiguous discs; integumental



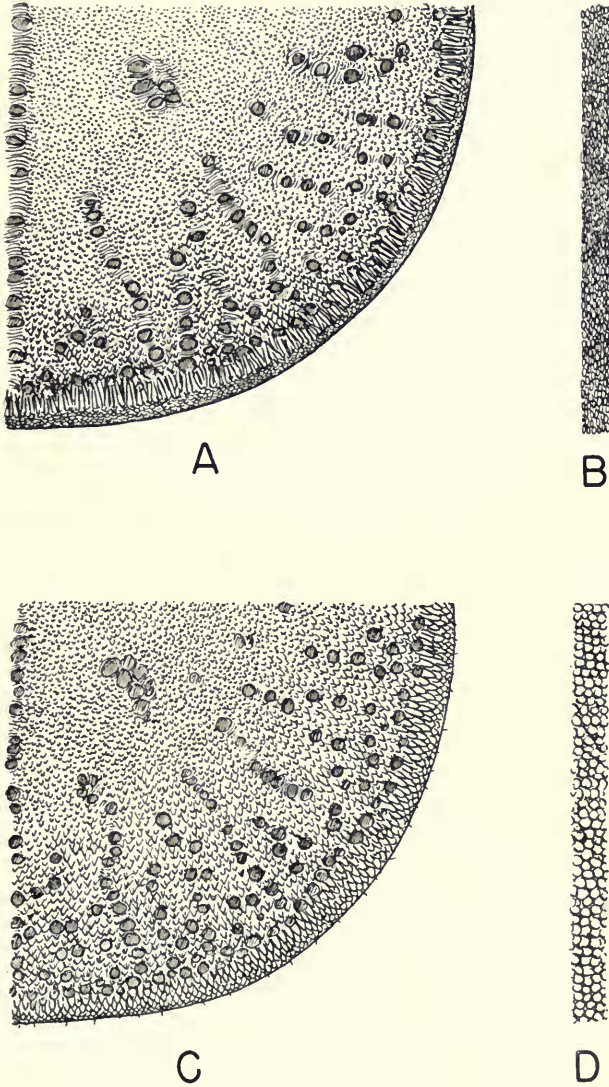
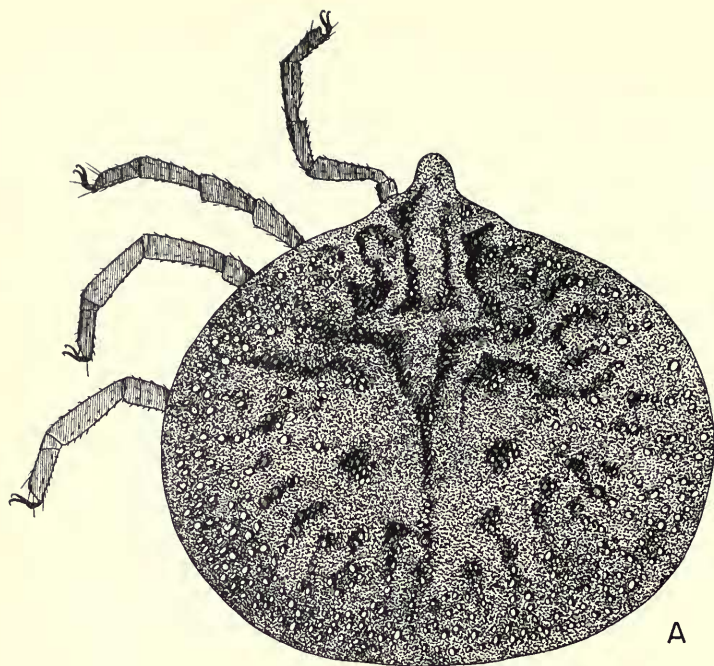
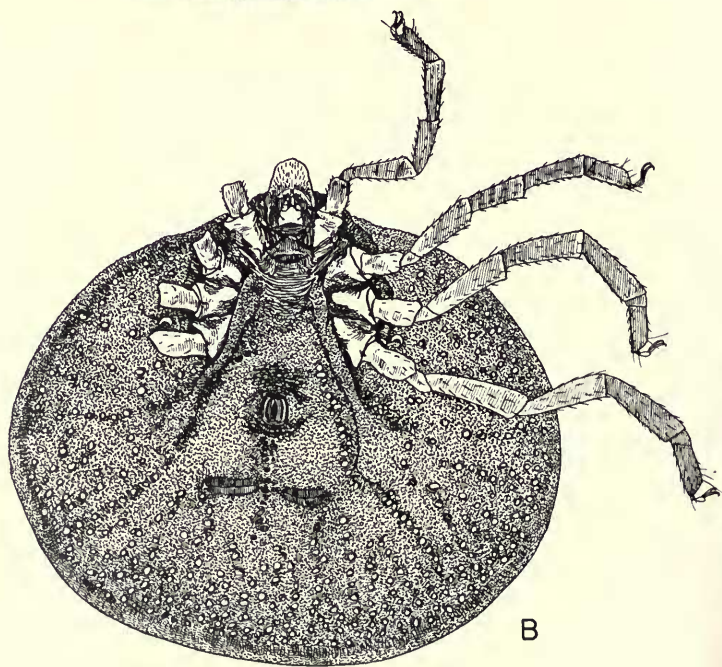


FIG. 126. Integument of *Argas boueli* Roubaud and Colas-Belcour, "small race": A, dorsal view; B, lateral view. Integument of *Argas confusus* sp. nov. (Egyptian paratypes): C, dorsal view; D, lateral view.



A



B

FIG. 127. Female of *Argas confusus* sp. nov. (Egyptian paratype). A, dorsal view; B, ventral view.

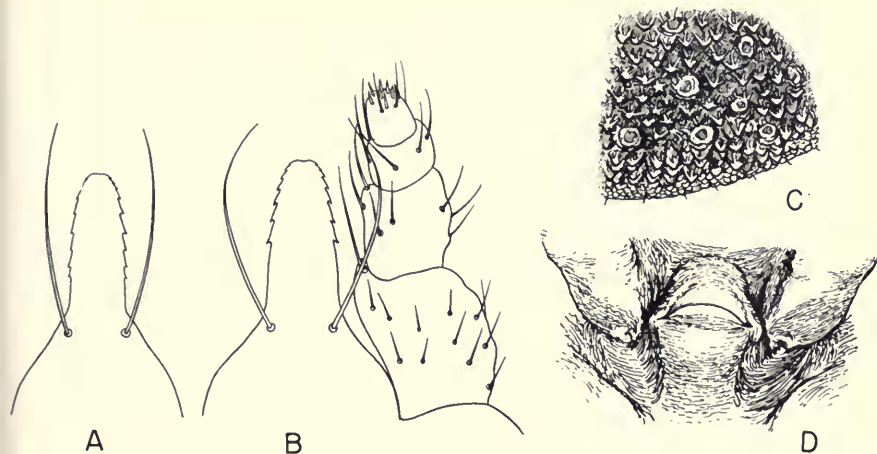


FIG. 128. *Argas confusus* sp. nov. (Egyptian paratypes). A, male, hypostome, ventral view; B, female, hypostome and left palp, ventral view; C, male, details of integument, dorsal view; D, male, genital area.

protuberances adjacent to discs often tending to be more linear than elsewhere. Hairs exceedingly minute and widely scattered, more numerous and longer on ventral surface of hood. *Peripheral integument* (when dry) differentiated dorsally only by more irregular, ridge-like rows of integumental protuberances, laterally by several rows of more closely spaced and more regular, flat-surfaced integumental protuberances; when the specimen is viewed in alcohol this differentiation is much more striking; laterally these same peripheral protuberances are quite distinct (either wet or dry), and ventrally they form a conspicuous body border (wet or dry); lateral suture absent. *Ventral integument* similar to dorsal but, especially posteriorly, protuberances much more irregular, many tending to be more linear; integument between genital aperture and anus consisting of horizontal ridges of linear protuberances (not visible on all specimens); *discs* conspicuous, arranged as illustrated. *Hood* large, yellowish, arising from anterior subtriangular body extension formed by juncture of supracoxal folds, thence continuing free to form a convex, bluntly rounded shield, directed slightly downward and extending anterior to the body; mouth-parts completely concealed from dorsal view. *Hairs* on integument extremely fine, widely scattered, inconspicuous.

*Capitulum* very small, in deep camerostome. *Basis capituli* wider than long, with widely diverging lateral margins. *Hypostome* about one-third as wide as long, with a single pair of files of weak lateral denticles (1/1) that become progressively longer basally, seven to nine denticles in each file restricted to anterior two-thirds of hypostome; apex slightly emarginate; a pair of long posthypostomal hairs extending beyond apex of hypostome. *Palpi* extending beyond hypostome by full length of segment 4; segments subglobose, progressively shorter from basal segment to apical segment, each segment with length and width ratio about equal.

*Eyes* absent. *Spiracular plates* situated lateral to coxae IV. *Genital aperture* straight, level with basal half of coxae I, lips smooth, anterior lip gradually rounded to form an arc. *Anus* elliptical, situated at one-quarter the distance between the



level of the anterior point of coxa IV and the posterior body margin; a row of five to seven fine, pale hairs on each slightly elevated valve. *Posterior paired organs* between anus and posterior body margin consisting of two clefts in a slight arc surrounded by shiny, striated integument without protuberances. *Postanal median groove* distinct, extending from anus between paired organs and for an equal distance posteriorly, thence indistinct or obsolete; with adjacent discs throughout its apparent length. *Coxal fold* distinct, extending from coxae II to posterior paired organs. *Supracoxal fold* distinct from juncture with hood to basal level of coxae III.

Legs arising from anterior half of body; leg IV (exclusive of coxa) the longest, three-fourths as long as body width; leg I two-thirds as long as IV, legs II and III progressively longer, III almost equaling IV in length; segments robust. *Coxae* elongately subtriangular, coxa I separated from II by an area of integument almost equal to its own width; other coxae adjacent to each other and separated only by a narrow, deep cleft. *Tarsus* I gradually widened apically, with the distal margin deeply emarginate; six hairs on each ventro-lateral margin, several on each lateral surface, two on the ventral distal knob, two median dorsal pairs, and a denser group around Haller's organ. *Tarsi* II to IV abruptly tapered from the distal two-fifths of their length to apex. *Pads* very small. *Claws* fine, recurved, those of leg I hardly longer than tarsal height, those of other legs more robust and longer.

**FEMALE:** Similar to male except for generally larger size, largest paratype measuring 8.0 mm. long (exclusive of hood) and 9.5 mm. wide. Genital aperture forming a straight line bounded by two rugose lips, situated at level of base of coxae I. Denticles confined to anterior half of hypostome and numbering seven or eight in each file.

**NYPHS:** Similar to adults except for size and absence of genital aperture; late nymphs may equal adults in size. It is noteworthy that nymphs acquire the short, broad, palpal characters of the adult and that their basis capituli is broader than long. The length and breadth of unengorged first instar nymphs are about equal, but as they engorge the body stretches transversely and assumes the characteristic wide outline of later stage nymphs and adults. The hood of nymphs, especially of first instar nymphs, is proportionately shorter than in adults. Second to fourth instar nymphs emerge from the exuvia with the broad body shape of the adults.

**LARVA:** Remarkably like that of *A. boueti*, described above, but with the following discernible differences: denticles numbering 14 or 15 in each file (rarely 13 in inner file); palpal segments 2 and 3 subequal; posthypostomal hairs reaching only to base of palpal segment 2; five hairs dorsally on each anterior quadrant of body and nine dorsally on each posterior quadrant.

*Remarks.*—Further rearing of progeny from numerous females is under way to investigate other possible differentiating criteria between larvae of these two species.

*Holotype.*—Male, from crevice of burial mustaba beside Giza Pyramid, Giza Province, Egypt. Collected May, 1951, by H. Hoogstraal. Deposited in United States National Museum, number 2205.

*Allotype.*—Female, data as for holotype.

*Paratypes.*—Fifty males, fifty females, fifty nymphs, and fifty laboratory-reared larvae, collected from bat-infested caves and build-



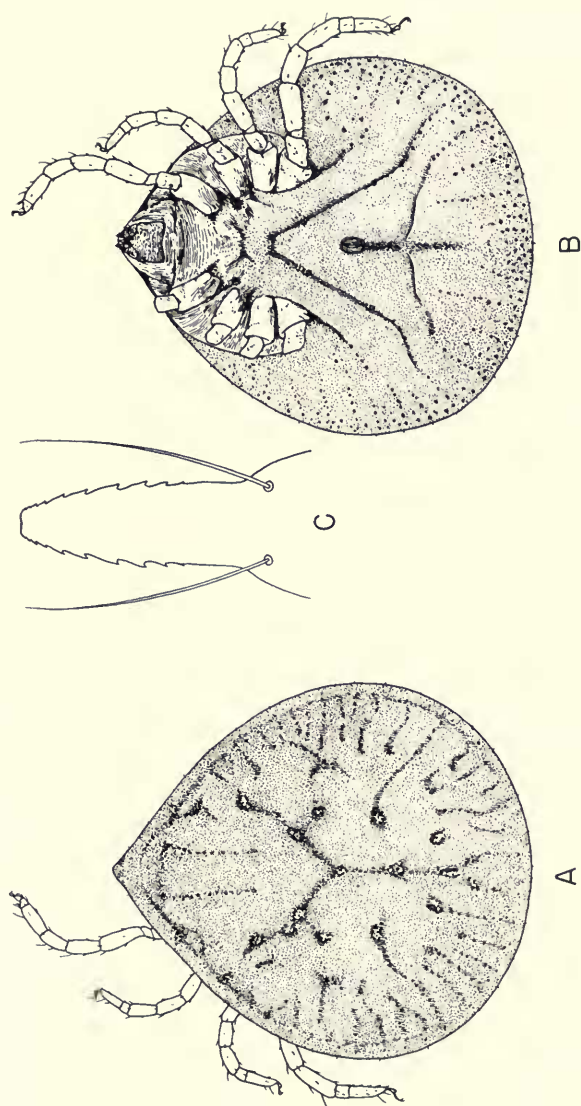


FIG. 129. First instar of nymph of *Argas confusus* sp. nov. (Egyptian paratype). A, unengorged, dorsal view; B, unengorged, ventral view; C, hyostome, ventral view.

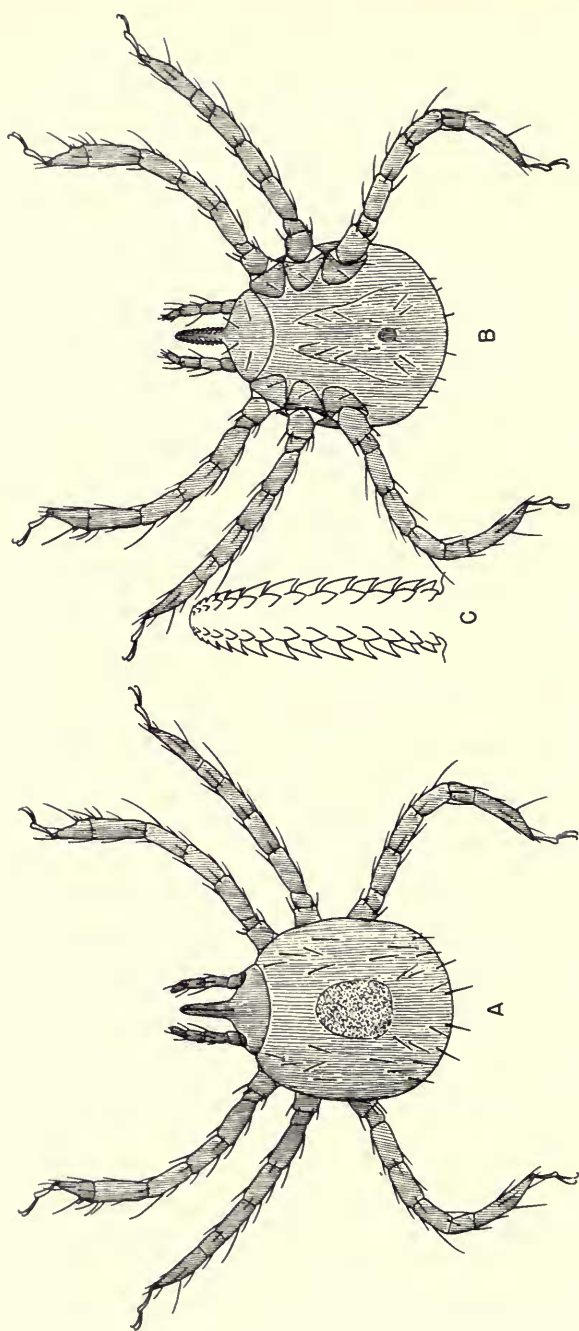


FIG. 130. Larva of *Argas confusus* sp. nov. (Egyptian paratype). A, unengorged, dorsal view; B, unengorged, ventral view; C, hypostome, ventral view.

ings in various localities in Cairo and Giza provinces, Egypt, between 1951 and 1954, by H. Hoogstraal, Abdel Aziz Salah, Makram Nasri Kaiser, and Sayed Mitwally. Also South African material from the following collections: Division of Veterinary Services, Onderste-

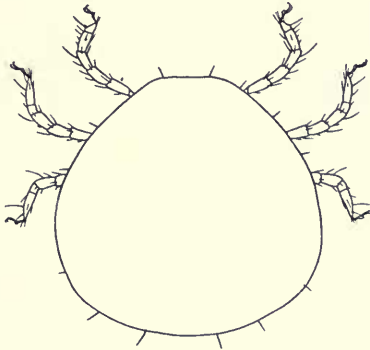


FIG. 131. Outline of greatly engorged larva of *Argas confusus* sp. nov., dorsal view. Egyptian paratype.

poort, South Africa: 2 females, 2 nymphs, house, Pretoria, October 16, 1932; 2 males, 1 female, 1 nymph, houses, Pretoria; 2 females, 1 nymph, "various South African localities"; 2 females, 1 nymph, house, Schoombie, March, 1953; 2 females, house, "Cape," February, 1938, collected by Bedford; 1 female, 2 nymphs, Lovedale, April, 1904, collected by Lounsbury; 1 female, Grahamstown, May 15, 1919; 1 female, office, Maseru, Basutoland, October 21, 1929. Rocky Mountain Laboratory: 1 female, house, Barberton; 1 female, bat, Pietermaritzburg. British Museum (Natural History): 1 male, house, Pretoria, January, 1932, collected by G. A. Bedford, Nuttall lot 3716; 1 female, 2 nymphs, received from C. P. Lounsbury, Cape Colony, Nuttall lot 975.

Paratypes from South Africa in the three institutions noted above are deposited in the collections from whence they originate, except that one Pretoria female from the Onderstepoort collection has been kindly presented to the Hoogstraal collection. Egyptian paratype material is deposited in the collections of the following institutions or persons: United States National Museum, Chicago Natural History Museum, British Museum (Natural History), Rocky Mountain Laboratory, Museum of Comparative Zoology at Harvard University, Division of Veterinary Services at Onderstepoort, Fouad I Entomological Society at Cairo, Museum National d'Histoire Naturelle

of Paris, Institut Pasteur of Paris, Dr. R. B. Heisch at Nairobi, and H. Hoogstraal at Cairo.

#### COMPARATIVE CRITERIA

Nymphs and adults of *Argas boueti* and *A. confusus* sp. nov. are readily differentiated from all other ticks by the characters proposed above for the new subgenus *Chiropterargas*. Our knowledge of *Argas* larvae is not yet wide enough to select limiting criteria for separating larvae of these two species from those of other species. Within this subgenus, larvae of *A. boueti* differ from larvae of *A. confusus* sp. nov. by only the following readily discernible characters: *A. confusus* has more hypostomal denticles per file (14 or 15) than *A. boueti* (11 to 13), and the dorsal body hairs of *A. confusus* number five in each anterior quadrant and nine in each posterior quadrant (as compared with six and ten respectively in *A. boueti*).

Nymphs of the two species are easily identified in their respective adult stages, especially in the second and subsequent instars. First instar nymphs of these two species, when unengorged, possess fewer differentiating characters, but may be distinguished by short, wide basis capituli and palpi in *A. confusus* sp. nov., and narrow, elongate basis capituli and palpi in *A. boueti*.

Adults of the two species differ in size and shape of body, legs, basis capituli, and palpi. There are also numerous lesser differences, such as in integumental protuberances, formation of the hood, and chaetotaxy of the palpi and tarsi, but aside from differences in the size and shape of the body and its appendages, noted above, the overall morphological characteristics of the adults and nymphs are remarkably similar. In larvae and first instar nymphs these differences are even less distinct than in adults and nymphs of later stages.

#### DISTRIBUTION, HABITATS, AND HOSTS

*Argas boueti* and *A. confusus* sp. nov. appear to be pan-African species, with the former, at least, also ranging into the Near East (Jerusalem). Collecting localities for each species may be seen in figure 132.

Habitats of both species are bat-infested caves, buildings, and tree-holes. Nymphs, adults, and engorged larvae rest deep in cracks and crevices or under rocks in these situations. Hungry ticks in retreats long unvisited by bats are often found on more exposed surfaces or wandering on the walls or floors. It is probable that these ticks are not to be expected in moist guano or caves. In Egypt, *A. confusus* is much more secretive than *A. boueti*.



Hosts of both species are bats. *A. boueti*, at least, in the experience of our staff bites man when he ventures into bat caves. Nymphs and adults feed on the host for less than an hour, as a rule, but larvae remain on bats between one and two weeks. Nymphs and adults probably attack the same bat species on which larvae are found.

We have taken larval *A. boueti* most frequently from the following bats: *Taphozous p. perforatus* Geoffroy, 1818; *T. (Liponycteris) nudiventris* Cretzschmar, 1826; *Rhinopoma hardwickei cystops* Thomas, 1903; *Otonycteris h. hemprichi* Peters, 1859. Less frequently we have found larvae on *Rhinopoma microphyllum* Brunnich, 1782; *Asellia t. tridens* Geoffroy, 1813; *Rhinolophus clivosus brachygnathus* Anderson, 1905; *R. mehelyi* Matschie, 1901; *Rousettus a. aegyptiacus* Geoffroy, 1810; *Nycteris t. thebaica* Geoffroy, 1818; *Tadarida a. aegyptiaca* Geoffroy, 1818; *T. teniotis ruppelli* Temminck, 1826; *Pipistrellus k. kuhli* Kuhl, 1819; and *Plecotus auritus christiei* Gray, 1839. In the Sudan, I have removed larvae and nymphs from *Taphozous perforatus haedinus* Thomas, 1915, and from *Rhinolophus lobatus* Jerdon, 1867. In Kenya, Heisch (1951) found specimens on *Megaderma cor* Peters, 1872, and our specimens from French Equatorial Africa were removed from *Eptesicus tenuipinnis* Peters, 1872. Roubaud and Colas-Belcour (1933) recorded their material from *Asellia* (= *Hipposideros*) *tridens* and *Taphozous perforatus*.

Larvae of *Argas confusus* sp. nov. have been found on the following species of bats in Egypt: *Taphozous p. perforatus*, *T. (L.) nudiventris*, *Otonycteris h. hemprichi*, *Nycteris t. thebaica*, and *Tadarida a. aegyptiaca*. Our Sudan specimens were removed from *Taphozous perforatus haedinus* and from *Chaerephon major* Trouessart, 1897, and questionably (because host field determinations were not checked by a specialist) from *Eptesicus pusillus* Leconte, 1857, and *Pachyotus* sp. In Kenya, I found larvae on *Miniopterus natalensis arenarius* Heller, 1912. I have seen specimens in the Onderstepoort collection from *Eptesicus capensis* subsp., from Southern Rhodesia.

Specimens of *Argas confusus* sp. nov., from Queenstown, Cape Colony, which Nuttall *et al.* (1908) described under the name *A. vesperilionis*, were stated to parasitize penguins there. Inasmuch as Queenstown is far from any normal penguin habitat, it is probable that either this host and locality record are erroneous or that the ticks were found on or in the vicinity of captive penguins in a bat-infested building.

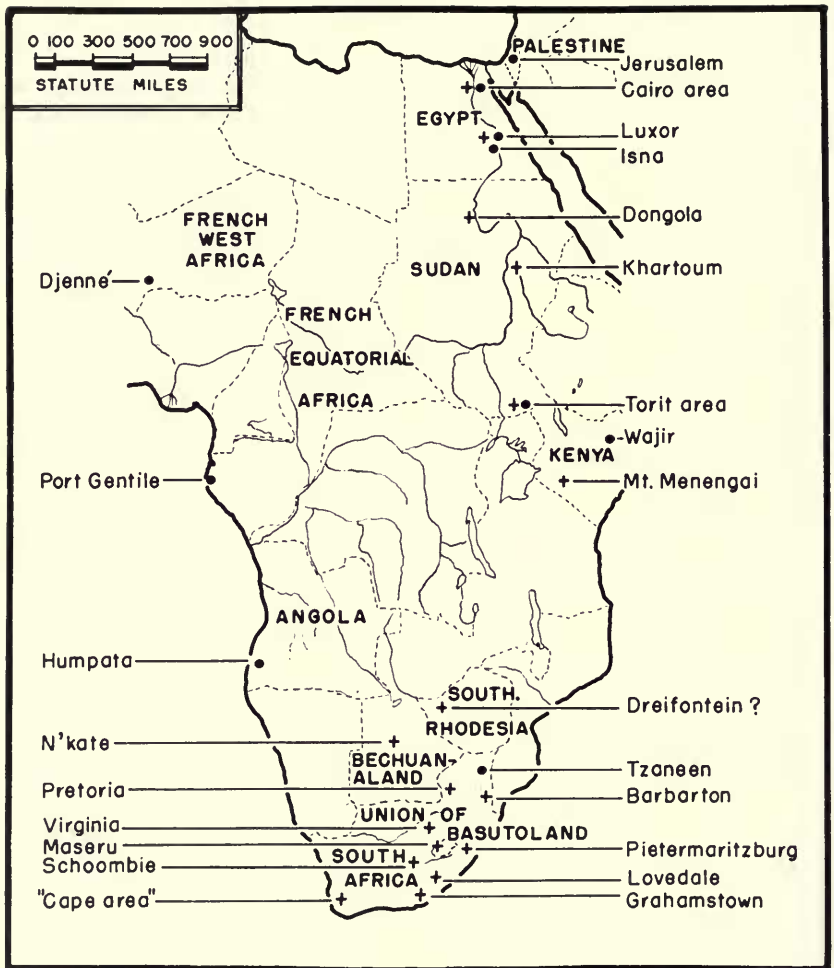


FIG. 132. Known distribution of ticks of the subgenus *Chiropterargas*.

## EXPLANATION OF FIGURE 132

### ● *Argas boueti* Roubaud and Colas-Belcour, 1933

- Palestine: Jerusalem (Hoogstraal, 1954a).
- Egypt: Cairo area (Hoogstraal, 1952); Luxor and Isna (HH).
- Sudan: Torit area (Hoogstraal, 1952, 1954b).
- Kenya: Wajir (Heisch, 1951).
- French West Africa: Djenné (Roubaud and Colas-Belcour, 1933).
- French Equatorial Africa: Port Gentile (CNHM).
- Angola: (Posto de) Humpata (OVSC).
- Union of South Africa: Tzaneen (OVSC).

### + *Argas confusus* sp. nov.

- Egypt: Cairo area and Luxor (HH).
- Sudan: Dongola and Khartoum (SGC, Hoogstraal, 1954b); Torit area (Hoogstraal, 1954b).
- Kenya: Mount Menengai (HH).
- Southern Rhodesia: Dreifontein (OVSC) (locality uncertain).
- Basutoland: Maseru (OVSC).
- Bechuanaland: N'kate (OVSC).
- Union of South Africa: Pretoria (OVSC, BMNH). "Cape Area," Grahams-town, Lovedale, Schoombie, and Virginia (OVSC). The record by Nuttall *et al.* (1908) from Queenstown is questionable. Barbarton and Pietermaritzburg (RML).

The authority for each record is listed, either as a reference to literature of known authenticity or as a symbol with the following meaning:

HH = H. Hoogstraal, personal collecting.

OVSC = Onderstepoort, Veterinary Service collection, seen by HH.

RML = Rocky Mountain Laboratory collection, seen by HH.

SGC = Sudan Government collection, seen by HH.

CNHM = Chicago Natural History Museum collection, seen by HH.

BMNH = British Museum (Natural History) collection, seen by HH.

## DISCUSSION

Since Nuttall *et al.* (1908) associated the adult of *Argas confusus* sp. nov. with larvae and nymphs of the considerably different *A. vespertilionis* (Latreille, 1802, not 1796), this adult has become an almost legendary animal among workers in Europe and Asia, who have frequently copied the figures in textbooks and faunal lists without seeing actual specimens. The publications of Sevenet (1937), Toumanoff (1944), Pantazi (1947), etc. contain examples of such repetitions. Others have described it from the illustrations of Nuttall *et al.* Actually, there is no evidence that *A. confusus* occurs outside of the African continent and it appears unlikely that it will be found elsewhere, except quite possibly in the Near East.

It is hoped that subsequent study of laboratory-reared progeny from more females will reveal additional constant differences between larvae of *A. boueti* and *A. confusus* sp. nov. Laboratory experiments and field observations are also in progress to elucidate the presently questionable relationships between the "small race" and the "large race" of *A. boueti*.

It is probably safe to say that both species in question are common enough in the drier parts of Africa so that specialized collecting among the cracks and crevices of bat-infested caves, buildings, and hollow trees will reveal a considerable amount of new data concerning both *A. boueti* and *A. confusus* sp. nov.

With regard to the great similarity between the larvae of these two species, it should be indicated that this is an exception to the general impression among students of argasids that the critical larval characters are even more significant than those of adults.

Details concerning the life cycle and biology of these two species, and also their role as vectors of pathogenic micro-organisms, will be published in subsequent parts of this series. The relationship of *A. boueti* and *A. confusus* sp. nov. to *A. vespertilionis* and related species will also be elucidated.

## SUMMARY

The adults, nymphs, and larvae of *Argas boueti* Roubaud and Colas-Belcour, 1933, are redescribed on the basis of numerous Egyptian specimens in order to indicate their similarity to and differences from related species. *A. confusus* sp. nov., a pan-African species, is described in the adult and immature stages; this species has been confused as the adult of *A. vespertilionis* (Latreille, 1802, not 1796) for almost fifty years. Habitats and hosts of both species are indi-



cated. The presence of a "large race" and a "small race" of *A. boueti*, currently being further studied, is noted. A new subgenus, *Chiop-terargas*, is proposed, to contain *A. boueti* (subgenotype) and *A. confusus* sp. nov.; its chief characteristics are absence of a sutural line and of well-differentiated peripheral integumental differentiation, and presence of a distinct hood.

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